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(54) APPARATUS AND METHOD OF FREEZING FISH ON BOARD A FISHING VESSEL

(71) I, DAVID JOHN DOUST, a Canadian citizen of Suite 417, 276 St. James Street West Montreal, Quebec, Canada H2Y 1N3, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to apparatus for freezing fish and to a method of freezing fish on board a vessel, and is an improvement on British Patent Specification No. 1,386,588 filed on February 26, 1971, entitled Apparatus for and a Method of Freezing Fish on Board a vessel.

According to one aspect of the present invention, there is provided fish freezing apparatus for use on board a fishing vessel and comprising one or more storage tanks adapted to contain a liquid refrigerant, one or more fish freezing tanks, fish carrying frames adapted to be lowered into and sealed within the said freezing tanks, the said fish carrying frames including a plurality of individually sealed fish carrying containers, refrigerant circulating means for circulating the liquid refrigerant from the said storage tanks to the said freezing tanks, and refrigerant draining means permitting flooding of the said freezing tanks with the liquid refrigerant while the said fish carrying frames are sealed within the freezing tanks and permitting drainage of the liquid refrigerant from the freezing tanks prior to unsealing and removal of the fish carrying frames from the freezing tanks while permitting continuous circulation of the liquid refrigerant by the circulating means even when the fish carrying frames are removed from the freezing tanks.

Preferably there are at least two independently operable fish freezing tanks.

Preferably the circulating means comprises a first common pump arranged for circulating refrigerant between the storage tank or tanks and all of the freezing tanks.

Preferably the draining means comprises a second common pump arranged for draining all of the freezing tanks. It preferably further comprises independently controllable draining valves in a circuit between a drain outlet of each freezing tank and the draining pump and a connection between the draining pump inlet and a position in the storage tank or tanks below the operational level of refrigerant.

The apparatus is preferably arranged whereby the freezing and draining cycle of each freezing tank is controllable by the opening and closing of the respective draining valve.

The circulating means in conjunction with the draining means enable the refrigerant to be circulated from the storage tank through the fish freezing tanks and back to the storage tank, the fish freezing tanks preferably having a refrigerant inlet pipe located in the bottom of the tank, an overflow near the top of the tank and a drain valve. Thus, in normal operation, while the fish freezing operation is proceeding, the drain valve is closed and the refrigerant overflow from the tank is returned to the storage tank after being filtered and cleaned and when the fish freezing operation is completed, the drain valve in the bottom of the fish freezing tank is opened permitting the refrigerant to drain out of the tank, preferably under the action of a draining pump, to at least the level of the inlet pipe located in the bottom of the freezing tank. Circulation of refrigerant can meanwhile continue.

The brine drained from the bottom of the freezing tanks can be recirculated through a by-pass line directly to a brine chiller and back to a make-up tank before being returned to the brine storage tanks.

Preferably the fish to be frozen are contained in sealed containers which are carried on racks on portable open frames.

Brine

Both the freezing tanks and fish carrying frames are provided with complementary guides whereby the fish carrying frames can be lowered into, or removed from, the freezing tanks so that lateral motion of the frames is firmly controlled whatever the amplitude of the vessel's rolling or pitching.

As the freezing tanks are practically empty of refrigerant when the tanks are being loaded or unloaded, even as circulation of the refrigerant is maintained while the drain valve is open, the operation of loading and unloading can be carried out and any splashing of the refrigerant onto the working deck is completely avoided when the freezing tanks are open. The opening of the drain valve of any one freezing tank is, therefore, sufficient to cause emptying of the freezing tank when the tank does not contain a fish carrying frame, and likewise its closure is sufficient to cause the filling and circulation of the refrigerant within the tank when the fish carrying frames are loaded and sealed within the tank.

A relief circuit is preferably provided for the draining pump in case all the drain valves should be closed at once. Thus the freezing tanks can be operated independently even with common pumps for circulation and drainage of the refrigerant. Thus on opening or closing of the drain valve, the fish freezing tank can be quickly filled or emptied of refrigerant and the loading and unloading of the freezing tanks can be carried out quickly and efficiently merely by opening or closing the drain valve at the bottom of the tank, and one freezing tank can be stocked while another is freezing.

There is also preferably provided a make-up tank into which the overflow of circulating refrigerant from the freezing tanks is directed and where the refrigerant is filtered to extract any impurities from it before it is returned to the refrigerant storage tank for recirculation.

A preferred form of the present invention will now be described with reference to the accompanying drawings in which:—

Figure 1 is a schematic sectional elevation view, showing the assembly of the installation of the fish freezing apparatus according to the present invention, including a diagrammatic showing of the refrigerant medium circulation and the sea water cooling circulation.

Figure 2 is a schematic plan view of the installation shown in Figure 1, showing in detail the refrigerant circulation system.

Figure 3 is a schematic plan view similar to Figure 2, but showing in detail the sea water circulation system.

Figure 4 is a schematic plan view similar to Figures 2 and 3, but showing the drain lines of the system.

Figure 5 is a partial transverse section of a fishing vessel, showing the fish freezing installation.

Figure 6 is a partial plan view taken on the line 6-6 of Figure 5.

Figure 7 is a plan view of the deck opening of one of the fish freezing tanks shown in Figure 5.

Figure 8 is a transverse section of the deck opening taken on the line 8-8 of Figure 7.

Figure 9 is an enlarged partial vertical section taken on the line 9-9 of Figure 7, showing in detail the sealing arrangement between the deck opening and the top end of a fish freezing container.

Figure 10 is a perspective detail of a removable corner vertical guide at the deck opening of the freezing tank.

Figure 11 is a vertical section taken on the line 11-11 of Figure 10.

Referring to the drawings, the fishing vessel is provided with port and starboard interconnected storage tanks 5 and 6 for the refrigerant medium, such as brine. These tanks 5 and 6 are shown here as being located in the space between the engine room bulkhead 7 and the fish hold 8.

Located immediately above the tops of the storage tanks 5 and 6 are the fish freezing tanks 9 and 10. These freezing tanks 9 and 10 have top openings 11 formed by the coamings 12 on the main deck 13.

Fish freezing frames 14 are adapted to be lowered into the freezing tanks 9 and 10 and the top ends of these frames 14 are sealed to the coamings 12 to prevent the leakage of the refrigerant medium at deck level during the fishing freezing operation.

Located between the freezing tanks 9 and 10 is a refrigerant make-up tank 15 into which the overflow of the circulating refrigerant medium from the freezing tanks is fed and is filtered before being returned to the storage tanks 5 and 6 for recirculation.

Referring now particularly to Figures 5 to 10 of the drawings, the bottom wall of the freezing tanks 9 and 10 are common with the top wall 16 of the storage tanks 5 and 6. The outer surfaces of the side walls 17 of the freezing tanks 9 and 10 are preferably lined with a thermally insulating material 18, such as expanded polyurethane with waterproof faced plywood. These side walls 17 extend to the under surface of the main deck 13 and are provided with a series of vertical stiffeners 19 and four vertical guides 20.

At the level of the main deck 13, there is provided a coaming 12 supported on suitable wedge members 21 to compensate for the camber of the deck. The coaming 12 is provided with a horizontal member 22 and a vertical member 23. At the inner peripheral edge of the horizontal member 22,

there is provided a weather bar 24 surrounding the periphery of the opening 11 of the freezing tanks 9 and 10.

The fish freezing frames 14 are provided with vertical corner members 25 which support a series of horizontal rack members 26 on which are placed individual trays 27. The trays 27 contain the fish to be frozen, which are sealed within plastic bags.

The lower ends of the corner members 25 of the frames 14 form feet 25a below the lowermost rack member 26a in order to provide clearance between thte rack member 26a and a perforated pipe 52 feeding the refrigerant medium into the bottom area of the freezing tanks 9 and 10.

The upper end of the freezing frames 14 consists of a cover member 28 having a peripheral downward facing channel 29 supporting a sealing member 30 adapted to make sealing contact with the peripheral weather bar 24.

Supported on the outer peripheral surface of the coaming vertical members 23 are a series of dog clips 31 adapted to be rotated into engagement with the seats 32 located on the top surface of the frame 28 in order to compress the sealing member 30 into weathertight engagement with the weath bar 14.

The freezing frames 14 are raised and lowered into the freezing tanks 9 and 10 by a suitable hoist mechanism 33 mounted on the underside of an upper deck 34.

In order that the fish freezing frames can be lowered into and extracted from the freezing tanks with ease, regardless of the amplitude of the vessel's rolling or pitching, removable corner guides 35 are mounted on each corner of the coaming vertical members 23. These corner guides 35 each consists of an angle member 36 secured by the flat head screws 37 and nuts 38 to the corners of the coaming 23. An inner angle guide member 39 is welded to the inner surface of the angle member 36 and the bottom edge of the angle member 39 rests on the top edge of the coaming member 23 when the guides are bolted in place. The angle members 39 project above the top edge of the angle members 36 and thus provide the guides for the corner members 25 of the fish carrying frames 14 when the frames are being lowered into the freezing tanks below. A shim 39a provides a smooth inner facing surface coplaner with the inner facing surface of the angle 39.

The make-up tank 15, located between the freezing tanks 9 and 10, is closed at the main deck level and has a bottom wall 40 provided with a drain opening 41. The side walls of the freezing tanks 9 and 10, which are common with the make-up tank 15, are provided with an overflow opening 42 at their upper ends. These overflow openings 42 connect directly with the upper ends of the perforated strainer tanks 43 located within the make-up tank 15.

THE BRINE CIRCULATING AND DRAINING SYSTEM

This system, as illustrated schematically in Figures 2 and 4, includes a brine chilling apparatus 44 and a brine circulating pump 45. The pump 45 draws the brine from the bottom of the storage tanks 5 and 6 through the pipes 46 and 46*a* and delivers it to the chilling apparatus 44. The brine from the chilling apparatus 44 is directed through the valve 47 to the top of the make-up tank 15 via the pipe 48. This circuit is used for pre-cooling the brine and wherever necessary to maintain the temperature. For normal circulation the brine is directed continuously through the valve 49 to the perforated pipe 50 lying on the bottom of the freezing tank 9, and through the valve 51 to the perforated pipe 52 lying on the bottom of the freezing tank 10.

After a fish carrying frame 14 is inserted into and sealed in one of the freezing tanks 9 and 10, the valves 53 or 54 are closed to prevent drainage of brine from the freezing tank 9 or 10 through the drain orifice 55 and pipe 56, thus permitting the level of brine in the tank to rise to the level of the brine overflow 42.

Circulation of the brine through the full freezing tanks 9 and 10 is maintained by the pump 45 until the fish carried in the frames 14 is frozen to the required degree, and is normally continued until all the catch is frozen.

When the freezing operation is completed in one (or both) of the freezing tanks 9 and 10, the valve 53 or 54 is opened and all the brine in the tank drops by gravity into the brine storage tanks below through a pipe 81 fitted with a normally open valve 80.

A common brine draining pump 57 is arranged to drain the brine from the tanks 9 and 10 upon the opening of a respective drain valve 53 or 54, to the top of the make-up tank 15 by way of the pipe 58 which leads into the filter tanks 43. This speeds up the rate of drainage. The filtered brine then flows down through the Y branch pipes 59 back into the storage tanks 5 and 6, as illustrated in Figure 5.

The valve 80 remains open whenever both drain valves 53 and 54 are closed to allow brine to pass through pipe 81 from storage tanks 5, 6 through the pump 57 thus enabling the pump 57 to operate continuously. This circuit can also be used to strengthen the brine by addition of appropriate salt to the filter tanks 43.

The presence of the open pipe 81 which leads below the level of brine in storage tanks 5 and 6 does not detract from the

drainage efficiency of pump 57 due to the height of liquid in the freezing tanks when they are full or partly filled. Likewise, the pump will never suck air from a freezing tank so long as pumps 45 maintain the circulation of brine at the bottom of the tank between pipes 50, 52 and the drainage outlets 55.

The brine drained from the tanks 9 and 10 can be returned directly to the pump 45 and chiller 44 by closing the valves 53 and 54 and opening valves 60 and 61 in a bypass pipe lines 62. This circuit is used when the temperature rises unduly.

Sea water for cooling purposes is taken inboard via the sea chest 63 and pump 64, as illustrated schematically in Figure 3. From the pump 64 sea water is directed into the condenser 65 of the cooling system and from there through the valve 66 overboard through valve 70. The sea water can bypass the condenser 65 by means of the bypass pipe line 69, leading directly between the valve 67 and the pump 64. For making up brine, the overboard discharge valve 70 is closed, valve 67 is opened and sea water led to the make-up tank 15 via pipe 68.

While the system is illustrated and described as having two freezing tanks 9 and 10 which would be adequate for the freezing of fish in smaller sized vessels, the number of freezing tanks could be increased for larger sized vessels.

In all installations, the size and capacity of the freezing tanks and fish carrying frames above described would be uniform, thereby permitting the fish carrying frames to be loaded into any one of the freezing tanks.

Where the installation makes use of more than the two freezing tanks illustrated, each freezing tank would have its own brine feed control valve, such as is shown at 49 and 51 in Figure 2, and a make-up tank and strainer tanks would be provided in the manner illustrated.

In the operation of this invention, the fish are placed in plastic bags and the bags are vacuum sealed and then loaded onto the individual trays 27 and the trays are loaded onto the rack members 26 of the frames 14. The loaded frame 14 is then attached to the hoist mechanism 33 above the freezing tank into which the frame is to be lowered. The guides 35 on the corners of the coaming 23 ensure that the frame will be accurately located in the openings 11 of the freezing tanks 9 and 10, regardless of the amplitude of the vessel's rolling or pitching.

Loading of the frames 14 into the brine-free tank is accomplished without fear of brine splashing out of the open top of the tank.

After attaching the removable corner guide 35 to the coaming vertical members 23, the fish freezing frame 14 can be lowered into the selected freezing tank (9 or 10) and secured therein by the dog clips 31. The valve (53 or 54) is then closed, thus shutting off the drain of brine from the operative tank and permitting the refrigerant to rise in the tank to the level of the overflow 42 from the tank into the make-up tank 15. The circulation of the brine within the closed tank is maintained.

When the freezing operation is completed, the drain valve (53 or 54) is opened to permit draining of the refrigerant from the tank so that the refrigerant can no longer rise above the level of the perforated refrigerant feed pipe 52, leaving the tank virtually empty of refrigerant. Only then are the dog clips 31 opened, permitting the frame 14 to be lifted out of the tank.

As the sealed containers 27 in the individual racks 26 are drained of refrigerant when the frame 14 is raised out of the refrigerant-empty tank, they can be readily separated and stored in the fish hold, and not be encased in a solid block of ice as is normally the case.

Due to the fact that the freezing operation in each of the individual freezing tanks (9 and 10) is controlled by the opening and closing of a single valve (53 or 54) while the circulation of brine in the system is continuous, the freezing operation can be carried out with a minimum loss of time. Additional fish carrying frames 14 can be loaded and be ready for lowering into a freezing tank as soon as a frame of frozen fish has been removed.

WHAT I CLAIM IS:—

1. Fish freezing apparatus for use on board a fishing vessel and comprising one or more storage tanks adapted to contain a liquid refrigerant, one or more fish freezing tanks, fish carrying frames adapted to be lowered into and sealed within the said freezing tanks, the said fish carrying frames including a plurality of individually sealed fish carrying containers, refrigerant circulating means for circulating the liquid refrigerant from the said storage tanks to the said freezing tanks, and refrigerant draining means permitting flooding of the said freezing tanks with the liquid refrigerant while the said fish carrying frames are sealed within the freezing tanks and permitting drainage of the liquid refrigerant from the freezing tanks prior to unsealing and removal of the fish carrying frames from the freezing tanks while permitting continuous circulation of the liquid refrigerant by the circulating means even when the fish carrying frames are removed from the freezing tanks.

2. Apparatus as claimed in claim 1 in-

cluding at least two independently operable fish freezing tanks.

3. Apparatus as claimed in claim 2 wherein the circulating means comprises a first common pump arranged for circulating refrigerant between the storage tank or tanks and all of the freezing tanks.

4. Apparatus as claimed in claim 2 or claim 3 wherein the draining means comprises a second common pump arranged for draining all of the freezing tanks.

5. Apparatus as claimed in claim 4 wherein the draining means comprises independently controllable draining valves in a circuit between a drain outlet of each freezing tank and the draining pump and a connection between the draining pump inlet and a position in the storage tank or tanks below the operational level of refrigerant.

6. Apparatus as claimed in claim 5 arranged whereby the freezing and draining cycle of each freezing tank is controllable by the opening and closing of the respective draining valve.

7. Apparatus as claimed in any preceding claim in which the circulating means includes a refrigerant chiller and individual valves to control the flow of refrigerant from the said chiller to the individual freezing tanks.

8. Apparatus as claimed in claim 7 in which the circulating means includes a perforated refrigerant inlet pipe located in the bottom of each of said freezing tanks.

9. Apparatus as claimed in any preceding claim in which a make-up tank is located between adjacent freezing tanks, and filters are mounted within the make-up tank, and the said freezing tanks each having a refrigerant overflow directed into the top end of a said filter, there being a drain connection from the bottom of the said make-up tank for return of the filtered refrigerant to the said storage tanks.

10. Apparatus as claimed in claim 9 as dependent on claim 4 or any of claims 5 to 9 as dependent on claim 4 in which the draining pump is arranged to direct the drained refrigerant from the freezing tanks to the top of the filters in the said make-up tank.

11. Apparatus as claimed in claim 10 in which the draining means includes a by-pass circuit permitting the drained refrigerant from the freezing tanks to be directed alternatively to the refrigerant chiller for recirculation.

12. Apparatus as claimed in any of claims 9, 10 or 11 in which the circulating means includes a condenser for the refrigerant chiller and a third pump arranged to direct water from the sea through the condenser, and a valve controlling the flow of sea water from the said condenser to the top of said make-up tank.

13. Apparatus as claimed in any preceding claim in which the said freezing tanks have openings arrangeable at the main deck level of a said vessel, a coaming surrounding the opening of the tanks, and clamp means on the said coaming, for sealing the top of the fish carrying frames to said coaming.

14. Apparatus as claimed in claim 13 in which the said coaming includes a peripheral sealing bar, and the said fish carrying frames have a peripheral sealing member at the top end thereof, the said sealing bar and the said sealing member forming together a liquid-tight seal when the fish carrying frame is lowered into a freezing tank and the freezing tank is flooded with refrigerant.

15. Apparatus as claimed in any preceding claim in which the said fish carrying frames include vertical corner members extending the height of the frame, the said corner members supporting a series of horizontally disposed fish carrying racks.

16. Apparatus as claimed in any preceding claim in which the lower ends of the said fish carrying frames have corner members projecting below the lowermost of the said fish carrying racks to provide a clearance space for a refrigerant inlet of a freezing tank.

17. Apparatus as claimed in any preceding claim in which a coaming surrounding a deck opening to the said fish freezing tanks includes removable corner guides projecting above the upper level of the coaming, the said corner guides adapted to guide the corner members of the fish carrying frame as the frame is being lowered into or removed from the freezing tank below.

18. Fish freezing apparatus substantially as described herein with reference to the accompanying drawings.

19. A fishing vessel fitted with fish freezing apparatus as claimed in any preceding claim.

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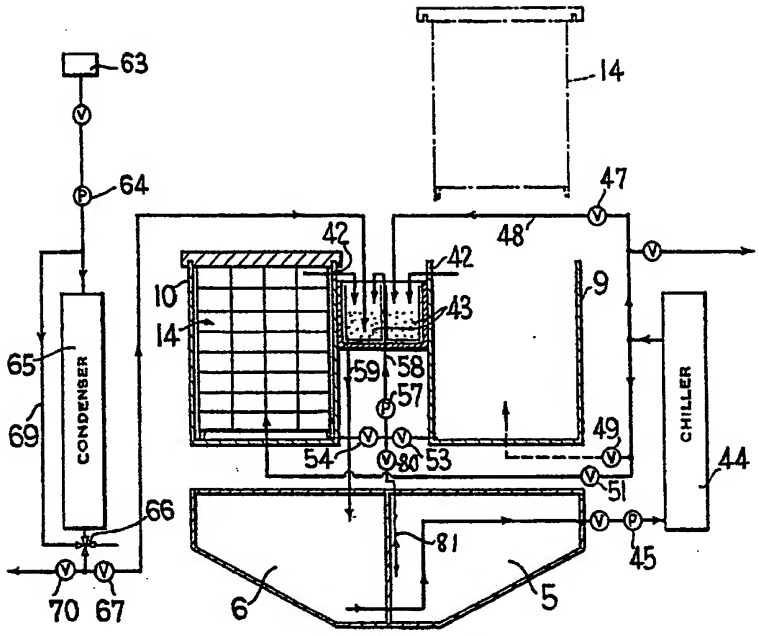

FIG. 1.

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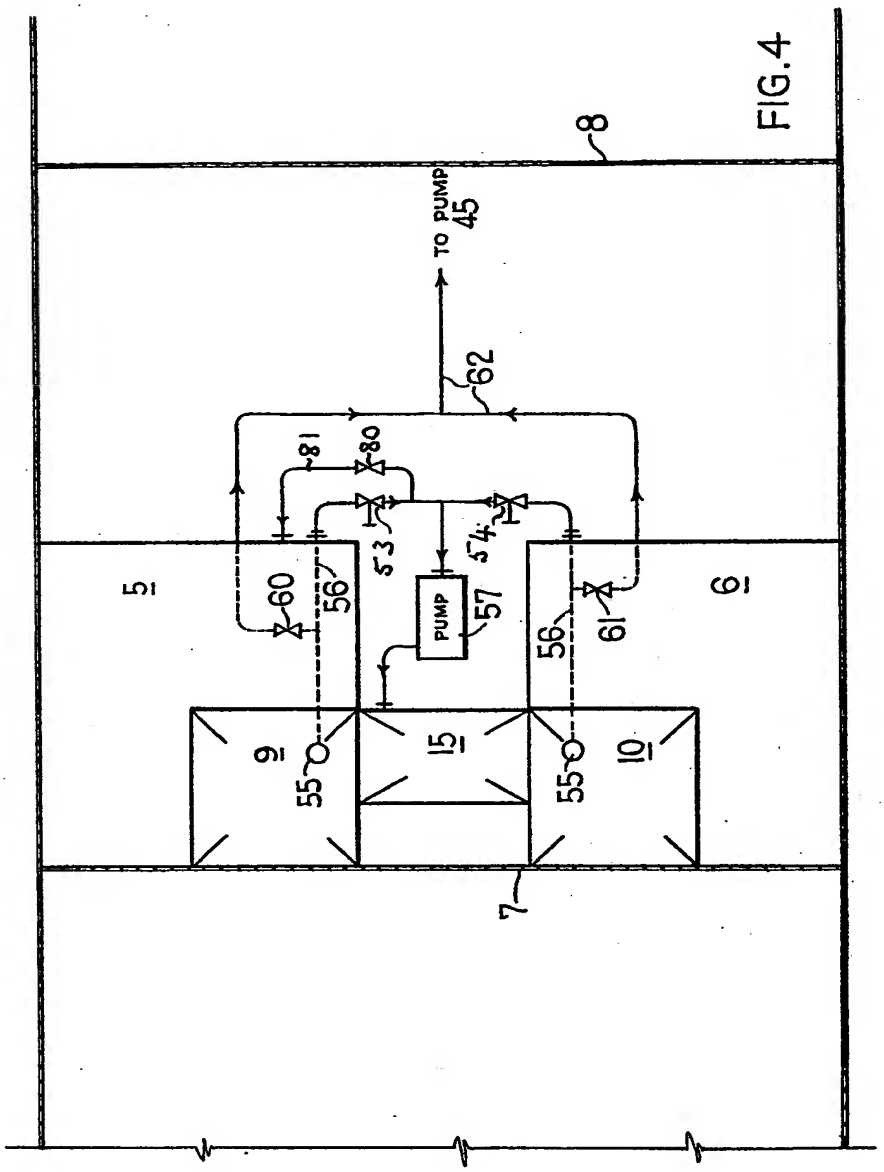

FIG.4

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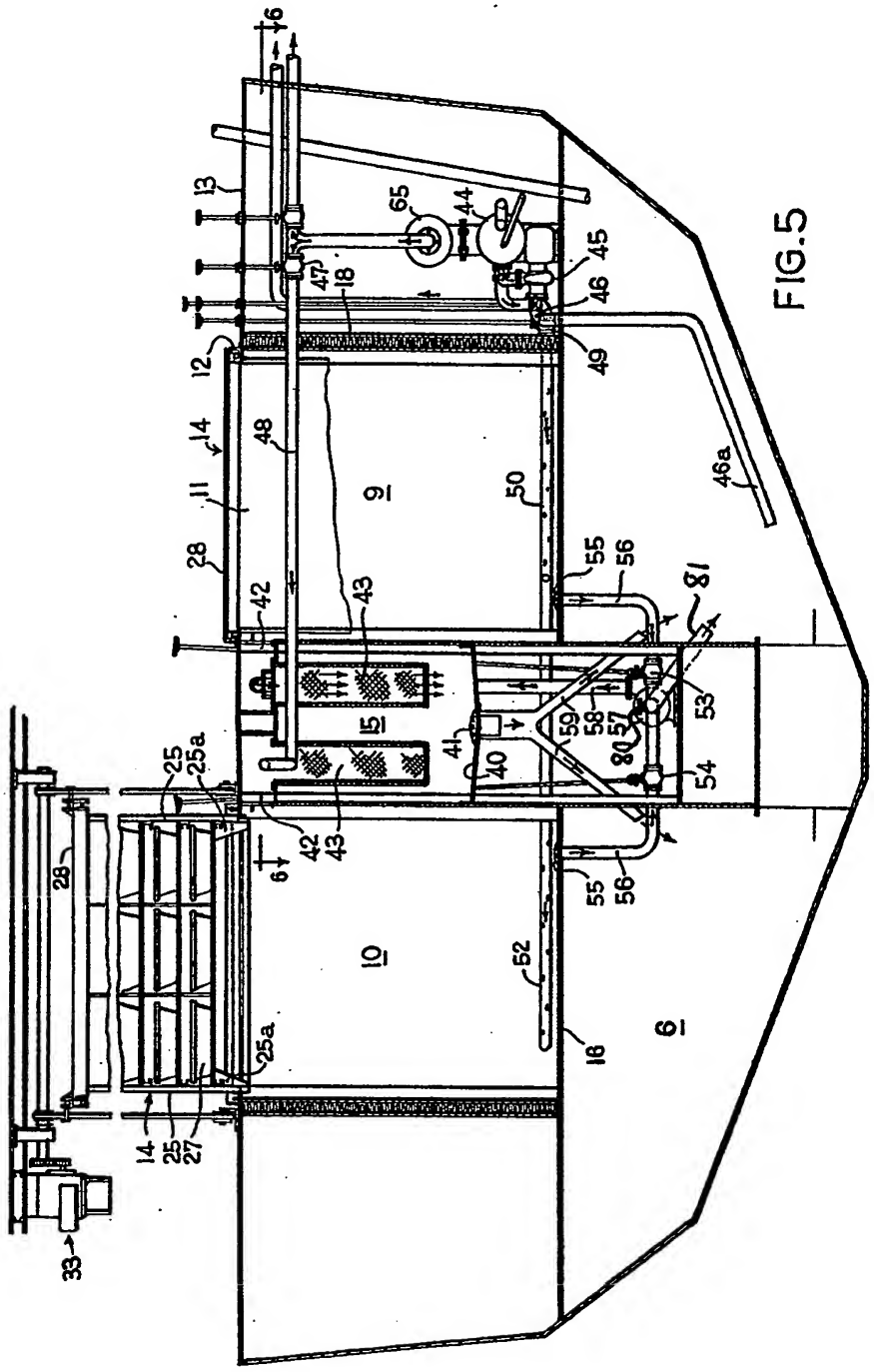

FIG.5

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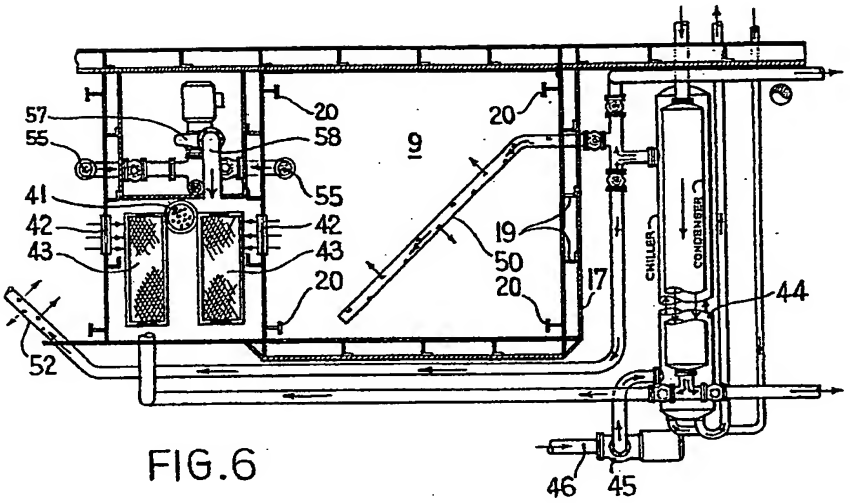

FIG.6

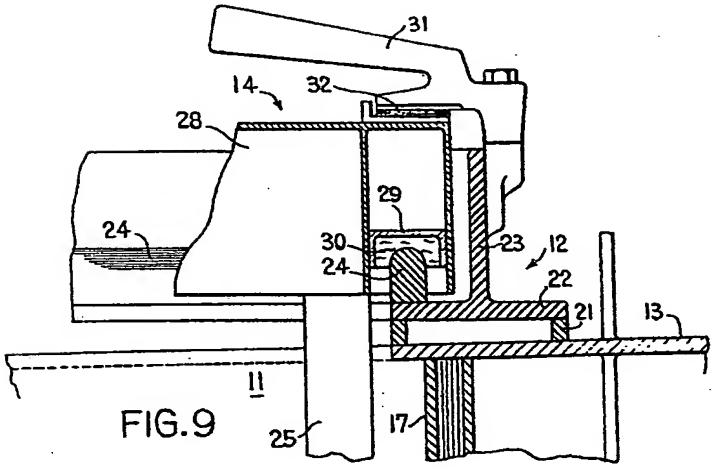

FIG.9

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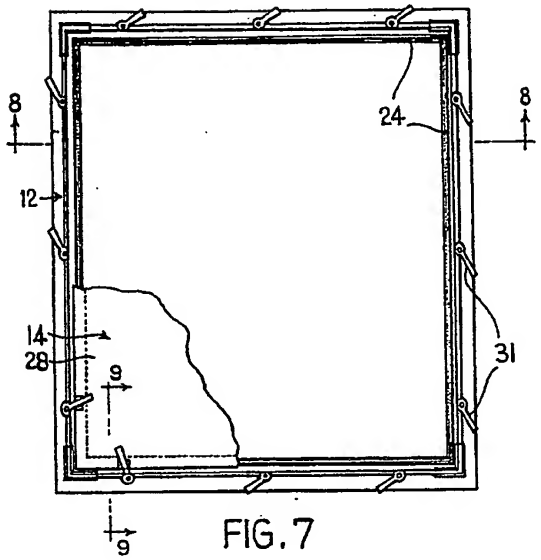

FIG. 7

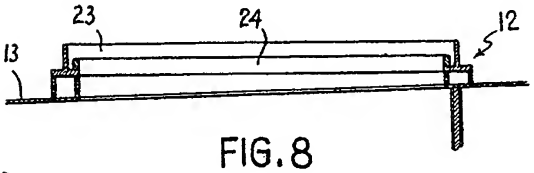

FIG. 8

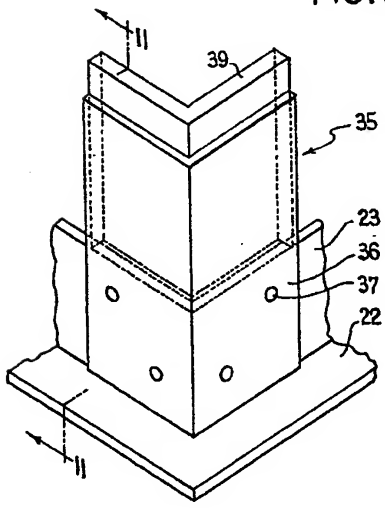

FIG. 10

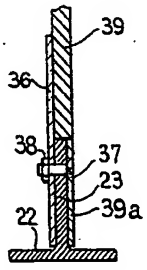

FIG. 11

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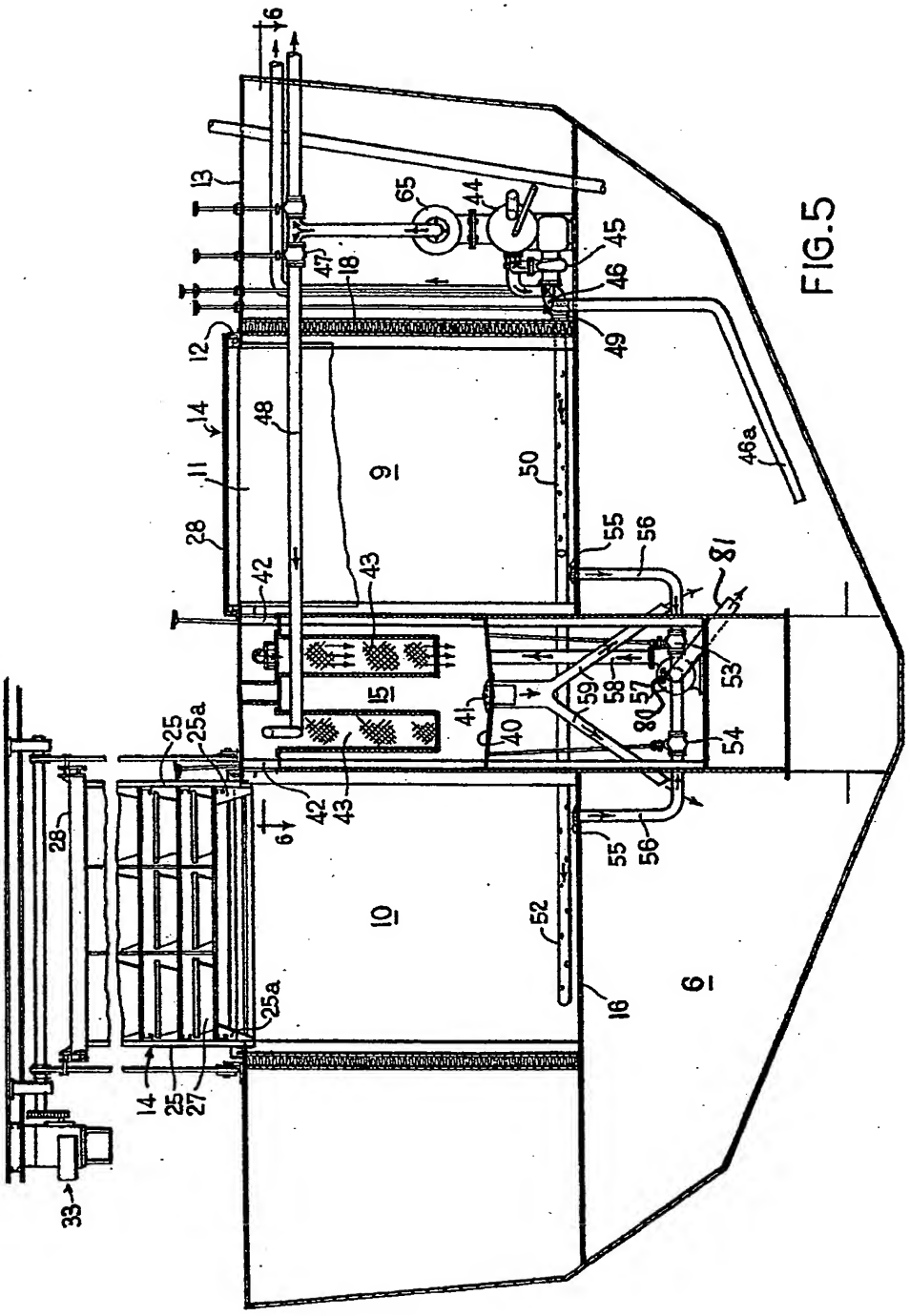

FIG.5

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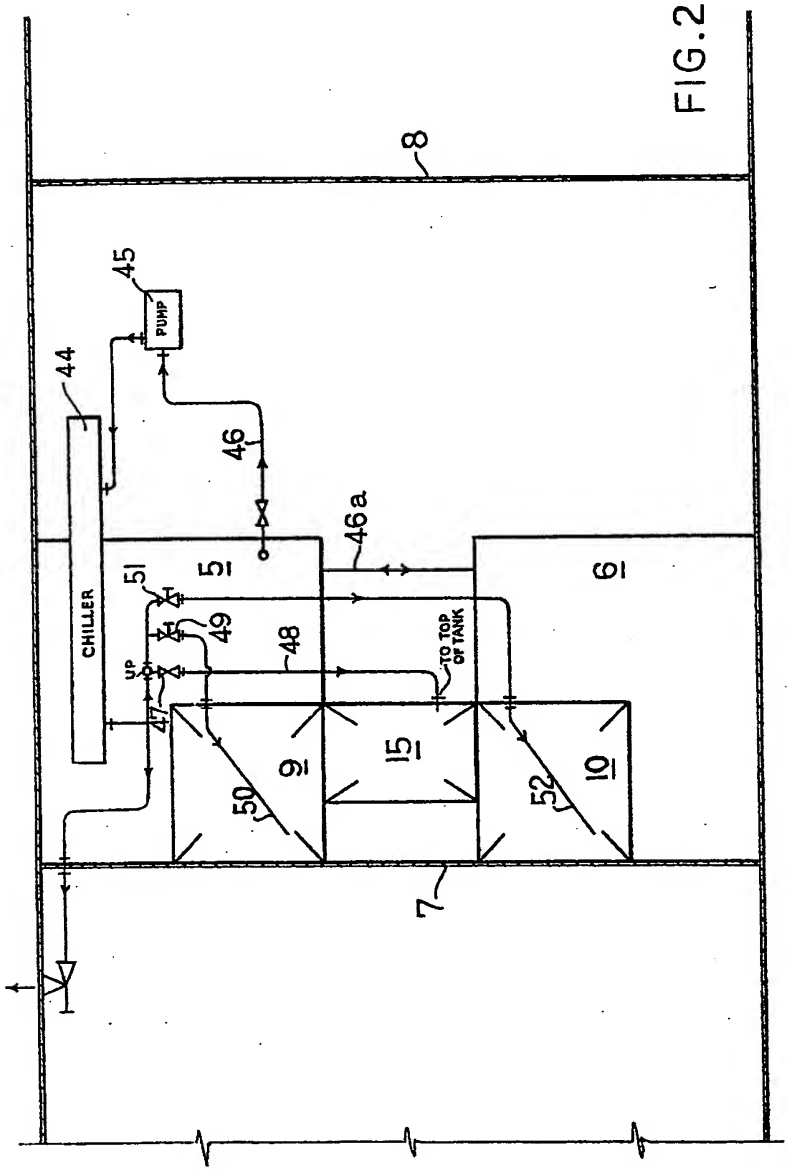
FIG.2



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